ADDRESS BY NASA ADMINISTRATOR

JAMES E. WEBB

BEFORE:

FRONTIERS OF SCIENCE

AND

MEMBERS CONGRESSIONAL DELEGATION

AT

LIBRARY OF CONGRESS

February 8, 1966

Washington, D.C.

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Thank you very much, Fred.

I'm not quite accustomed to being here with distinguished men, like Mike Monroney and so many members of Congress out there. I really came here to listen to the Vice President and to be with you, our friends from Oklahoma, while he was here and to make sure he got a full picture of the importance of the efforts of the Frontiers of Science foundation. I started to say movement because that's what Sandy Draper characterized it in the early days. He said he didn't know how to call it anything except a movement. But while you're waiting for him maybe I can say just a few words that may be of interest to you.

First of all, I've been asked to comment on the Russian soft landing on the moon and the pictures which were released first by the British and then by the Russians and to say why the United States didn't get ahead of the British and release them ourselves.

Well, I think first of all without in any way admitting that we monitored the Russian shots or would have been able to intercept those signals had they appeared on this side of the Earth, I'd like to say that the moon was on the other side of the Earth when that landing was made and those transmissions were made and the Russians were smart enough to put it on the side of the moon that was going to remain visible to them and in sunlight for a period of about twelve to fourteen days. But it was not visible by radio or sight from this side of the world. It

was visible to the (~~Inaudible~~ Goddard) Observatory and (Inaudible Lovell) monitored these signals apparently and as they came in, being acquainted with electronics he noticed a sort of a pattern within the signals as they came in. Suddenly some fellow there with him, or he, realized well this is just the same kind of thing you see with a facsimile transmission for newspapers. So they started to run it through a facsimile machine and, lo and behold, out came a picture. So there's a certain amount of serendipity in it. (Laughter) I think it's extremely interesting to speculate as to whether somebody in Russia is now facing a serious inquiry from the equivalent of the United States Senate or the House of Representatives as to why that was permitted to take place. (Laughter)

I think in Houston when I met you there and at Cape Kennedy, and also recently when I was in Oklahoma City, I made it very clear that the Russian program is on going, vigorous, well financed, and is clearly a very major part of the effort of that nation to use science and technology to drive ahead its ability to be an effective nation to have its way in the world. And this lunar soft landing, coming I think on their ninth try or so, is simply an indication of the fact that when they start out to do something they keep trying until they do it. This has been the history of their program, while we ourselves have had a broadly based program carrying forward scientific efforts that would give us a broader understanding of the space environment and of the air and of the effect of the sun on our atmosphere, anddetermining what it means to realize that the sun is now sending out a solar wind that's about twice as fast as it was just two or three years ago, that the solar wind is now blowing, when they have erupted, at about 1,600,000 miles an

hour. Just two or three years ago it was blowing about 500,000 miles an hour.

So you see the solar cycle is moving on and we're trying to understand the environment so we can make more efficient machines. They're undoubtedly doing the same thing. But they pick an objective like trying to get pictures from the surface of the moon. They just keep trying until they get it. Just like they kept trying with every other program and they have two probes on their way to Venus right now.

But the indications, of course, of our hard surface on the moon is very valuable because there's been a lot of speculation as to whether you'd be swallowed up in dust if you landed on the moon, and a lot of other things like that. Now there isn't any doubt that a landing can be made because one was made and at least we have seen picture of the lunar surface taken from close up and with sufficient detail and with sufficient clarity and with sufficient detail to have a pretty good idea that we could go ahead.

We are expected to do the same thing in a few months, or certainly during this year. We have four engineering flights with a Surveyor and there's no doubt in my mind that we should pursue those because the moon may be very different in one place than it is in another place. And further, our machine is intended to dig a little hole and to make certain chemical analyses of the material and to give us valuable information over and beyond what a picture can give us.

Let me, however, not try to cover the whole space program because most of you have seen it in our different installations, but rather to say that we still have in the United States a lot of people who don't

understand what it means to drive forward with a very major program that involves a science, a technology based on science, engineering to use that technology, and management to produce things that are useful out of it.

We have just this last week, as you know, turned over the first operational weather satellite to the Weather Bureau, Essa I, having finished our own research and development program with ten Tiros flights. And this satellite is working wonderfully and is going to be followed with another satellite very shortly. There'll be an operational system there that will do a much better job than the experimental satellite we have been flying, even though we did feed the information from the experimental satellites into the whole weather operational and forecasting system.

Let me point out that the Communications Satellite Corporation is already now finding that the technology and the scientific understanding of the environment out around the Earth permits them to make plans for a very much more sophisticated and more durable and more efficient satellite than they had in mind even as much as six months ago. So you are going to see a very rapid progress toward these utilizations of satellites for useful work with respect to weather and communications of things right here on Earth. And of course we are proceeding rapidly now to the final stage of developing our capability to operate out as far as the moon with men and we already see an exclusion from that in the military services where a man's orbital laboratory is under construction which the military services will use to experiment with men in orbit around the Earth for improving the efficiency of our military services.

Now this kind of total bank of technology and careful examination of how you pull out of it either a commercial communications satellite system or military communications satellite system, both of which have been pulled out of it, or as Senator Monroney has been so interested in, a supersonic transport airplane and short take-off and landing airplane, I think we're going to see much more of that over the next five years.

And I have said to Mr. McGee and to Senator Harris here that I certainly would applaud your efforts to look ahead for another five or ten years and figure what you in the Frontiers of Science foundation are going to do yourselves in Oklahoma and in your region as this system moves forward. Let me put it to you in a slightly different way.

You have had in this country with the atomic energy programs, the aeronautical programs, the ballistic missile programs and the space programs, something like a hundred billion dollars voted to an expansion of science, expansion of technology and engineering application of the technology, and then the newly developed capacity to manage very large efforts in these fields. Now we are seeing much more, as you've heard from some of the officials you've talked to, Mr. Holloman I believe talked with you a good deal about this, of an effort to make the most of these things.

While the Senator has introduced Dr. Mumford as the head of the Library of Congress, the man that we look to there which is symbolic of this situation is Dr. Ed Wink who was in the Executive Branch and was in the office of the President, but he's now got a whole organized section in the Library of Congress aimed at making this total knowledge available out of all of this system available to members of Congress,

as they consider their legislative duties and require thoughtful, careful, self-examination of it.

If you're going to look ahead and ask yourself what does the extrusion of these great big operation systems mean, what does a continuation of a forward thrust in each of the major disciplines that's involved in understanding the Earth and the area of space through which the Earth moves, and developing and understanding of the Earth's atmosphere by examining the atmosphere of Mars and Venus so you get a general theory of planetary atmospheres, if you ask yourself what it means to push those disciplines forward and to use those kind of theoretical bases and foundations for better technology, and in the space program alone we have about 20,000 industrial companies picking up and developing and using this kind of technology, and then if you move on to the question of how this kind of a management experience can be applied say in the field of oceanography, or to the intricate relationship by which a supersonic transport system is going to be developed. Now I'd like to stop right there and talk about that word intricacies of the system that have to be developed.

And again, I'm sort of filling in. I've got my eye on that door. The minute the Vice President comes in, I'll sit right down.

The intricacies are far greater when you move out beyond the shores of the United States. If you develop an airplane that's useful here and then put it into international traffic, you still encounter a great many difficulties. But if you develop a major airplane system that is aimed at serving the international market at three times the speed of sound and realize that the whole airport and other transportation systems of

the world have to be reorganized to take advantage of this service, and that you have difficulties of bureacracy and problems of how do you get rid of the previous investment, and you just write it off and take it as a loss, you realize that we are running into a lot of problems that no one really understands how to handle. Right now, and this is something I'd not want to see published because I don't know just exactly what the problems are that would be involved, there are certain countries trying into the Comsat Corporations that could expedite their international telephone traffic very much. They could almost give you as good telephone service through Comsat Corporation as you could get right here in the United States by dialing a number. But their local service frequently requires a wait of an hour or two to complete a call. So you put in a call to somebody a hundred miles away and it takes you an hour or two to complete it. Now the government in some of these countries is taking the view that they will not permit the international service to be expedited so that there's that kind of a comparison where you can get an instant call to the United States but you can't get one a hundred miles away except with a wait of an hour or two. There's all of that kind of intricacy that comes into being.

The subterranean and subsurface cable system that these telephone traffics throughout western Europe has developed over many years, a very complex network, it's all tied to the traffic pattern and the question is how do you get rid of this very large investment in a superseded area in order to take advantage of a much more efficient and rapid method of handling this traffic.

Now we in the United States, if we're going to develop the capability

to instantaneously talk to anybody in the world, or put television pictures, or take a problem in one country, put it in a computer in another and get the answer back, we've got to learn how to deal with all this accumulation from the past. And then I would say management, administration is going to be probably as much of a key to that as the science or the technology or the engineering.

Now when I go to Europe in about another month or six weeks or so, the President's asked me to go to talk to Europeans about building a complex spacecraft, I'm not really going to talk to them about cooperation in space so much as I am to say that while the policy of this country is not to encourage people to build hydrogen bombs and get what they call proliferattion of that capability, or even ballistic missile systems, a proliferation of delivery systems, that all of the technologies that these countries need to integrate with us in many of these matters and to judge what is in their own interest can come from developing a very complex spacecraft. We'll launch it for them. So you don't get the booster problem. You don't get the bomb problem. But you do get them to work their industries, work with American industries, where maybe a third or half the funds would be spent with our industries, and you get on a basis where their 200 million people and our 200 million people are asking how can we make the pie bigger for all of us instead of complaining about the brain drain, or technological imperialism done when we invest our money over there.

We have got a lot of very complicated accumulation of problems may erode even the present rather limited stability among the nations that know how to use mouern technology. And this doesn't even touch on

the problem of the nations like Africa and South America that don't yet know very much about this.

Bringing this back to Oklahoma, I've always had a very strong feeling that Oklahoma didn't have a lot of the kind of impediments that I've been describing. You don't have the pollution of air and water and things that these big cities have. You don't get paralyzed when it snows. And you've still got that frontier spirit of getting out and doing something, of moving out, of feeling that the future is in front. And it seems to me if you would approach some kind of a participation in the system of science, or technology, or engineering and management and begin to put the three together that you'd find a tremendous bank of knowledge opening to you. You would find a large number of people just as Mr. Holloman said to you, there are a large number of people know the country has got to solve these problems. They just don't know how to solve them. They're looking for somebody who's willing to experiment, with the efforts to solve them.

And Sandy, where is Sandy Draper, you know this is just what we did more than ten years ago. We found many people, Dr. Bush, Dr. Berkner and Dr. Kelly, every time we said we're going to do something in Oklahoma, they said fine, what can I do to help you. I think you'll find that kind of people now but you'll find them in a much more sophisticated relationship with less time to help you, less concern than they had after Sputnik, and with more of a requirement that you think in these four items, including management and administration, than you found a few years ago.

So I would certainly strongly encourage you to work in that direction.

I still don't see anybody there, so I'll give one more idea.

The Space Agency has always been a sort of experimental outfit. In the days of aviation the basic idea was to develop new theories of aerodynamic or propulsion efficiency, to try them out in a wind tunnel. Then to build a flying model and then when you got a production model to go back and examine that to see how it matched up with the theory and with the test so that you could do what they call scaling. So having got a good flying model that you could say well the theories showed us this and this realized 85%, well if we built one ten times as big it'll still be about 85% of what we predicted when we started with theory. This is what they call scaling.

Well in NASA we're trying to scale management problems upward to understand how to handle very large management systems. Now in doing this we find very very few people who even understand what it means to put the effort of 5,000 companies together, not to speak of 20,000, of how to examine the problem of getting participation by a large number of educational institutions in the building of a spacecraft that's going to have, say, twenty different experiments in it and take twenty measurements simultaneously. And that has all got to come back and match together and you get the information you need from the total structure of those measurements.

So what we are about to do now is to open up the management centers that we have at Huntsville and Houston. At each of those centers we handle about $1.5 billion a year of volume. Ninety percent of the work is done by American industry and we have control by which we manage the cost, performance and schedule factors through technical people in

technical laboratories but they still have to fit into the contract officer who's going to decide how much money to pay that contract at the end of the month. And if it's incentive contract you've got to measure the factors that determine the bonus and some of these companies are now earning from $1,500 to $2,000 a day bonus on their spacecraft because they have worked maybe twice as long as they contracted to deliver the spacecraft to work.

So all of that has to be figured through this system of management in control. It ultimately comes down to how many dollars of your money, your taxpayer's money, do we pay that contractor and for what, and leave a record that the General Accounting Office and congressional investigating committees will be satisfied that it's honest, proper and a good expenditure of funds.

So we are now trying to find a first class man who understands management and the theory of management, who understands total systems engineering, who understands not only the (inaudible) system but also the cost, schedule and performance factors that we have to have when we take a rocket to the Cape to fly. We've got to be sure that we've got everything in it right and that we haven't overrun our budget, and that it is there at the time the other equipment is there to fly and that the ships are out in recovery forces, and all of that.

To examine this kind of thing, we think if a man went, say, on the faculty of the University of Alabama where they have a campus right next to our installation there, and if we then made him a consultant to NASA, which would increase his pay somewhat, maybe a few thousand dollars a year, and give him the full run of this management room and let

him then organize a graduate seminar under the auspices of the university with people from our contractors, of which there's ten thousand down there, our personnel of which there's seventy-five hundred, the Redstone Arsenal personnel of which there's seventeen thousand, and the contractor for Redstone of which there's, say, about another twelve thousand. Together there's sort of a large number of people interested in this kind of thing. If we could have a constant feed-back through the mind of an educator, a scholar, a guy who works to organize a graduate seminar, examining this process and then get a few predoctorals from around, maybe from Oklahoma, we have two from Minnesota, one now at Houston, to write their dissertations on data that is available in that management center that never heretofore has ever been made available, it seems to us we may be experimenting with a new and better way to do things. I'll guarantee you that no company like General Motors, or even the Oklahoma Gas and Electric, is going to let you come in and look at their central management control room and use it as a teaching laboratory like Brookhaven has used (Inaudible) experimental work.

We're prepared to do that. We're prepared to open this because we aren't circumscribed with classification problems like the AEC or the DOD. And we are working with American industry and we are working with over 190 universities. So we want to take this next major step if we can find good partners to do it. Now this means that the university has got to take a real responsibility to look at how research as well as education can evolve from this and they must make sure they protect the right of these companies where the total problem of meeting their production schedules and costs flows into this control room. So you see we

need an interfaith that is just like a doctor or a lawyer, he doesn't tell everybody what his client's business is. But we still can, I think, extract this knowledge and put it into a system that will advance the state of the arts.

Remember, again, that while the government is now deeply concerned with how we move in space and that the Russians don't develop a capacity that will really cause us a lot of trouble, we're deeply concerned with developments in oceanography, deeply concerned with the interface between the air, the ocean and space, which they call environmental sciences. And we know already from the information we have, very clear from that information, that the use of the air and the use of the ocean and the use of the area just above the air is going to expand at a far more rapid rate than the use of any similar penetration of environment has ever expanded. If you realize that we've only seen Sputnik fly only eight years ago, a little over eight years ago, we saw our first satellite fly in January of 1958. That's only eight years ago. Just think of the tremendous development has occurred since then, whole systems serving the world already out and operating. And with some agreements with the Russians to exchange weather data, for instance, over a line that's constructed between Washington and Moscow, we already have that agreement. They haven't yet flown their satellite. Ours is up. But they have promised, Mr. ~~(Inaudible)~~ Blagonravov told me in New York about three weeks ago, I went up and had lunch with him, that very shortly they'd be producing this data. And again, I'd prefer for this not to necessarily become a matter of speculation in the papers because I'm anxious to have him want to have another talk with me rather than to feel that I'm going to tell

the papers everything he says. We have not had any willingness on their part to tell us the kind of experiments they have on that probe that's going to Venus, for instance, or to tell us maybe some of the frequencies that might be used to exchange information by using the Echo balloon, Echo II. I mean they simply will do certain things but not others. It's going to be very interesting as we move toward Europe and, say, to Germany and England and the other countries, if you want to cooperate you can benefit in the technology that will help your whole industry and provide a better relationship with American industry. Whether Mr. de Gaulle will be as standoffish as he has been in the past, it'll be very interesting to know whether he would like to see that develop without him in.

What I'm trying to say is the next thrust will probably not come on the basis of fear of the Russians or hope for American dollars because neither one of those is going to be as strong as it used to be, but rather on the feeling that out of advanced technology on a sound foundation of science and constantly driving ahead with administration and management, utilizing these forces and working with them in a way satisfactory to the scientists, the universities and the others, we can make another very major forward thrust with not just theoretical things but visible things like Earth satellites producing weather that you couldn't get any other way and measuring a lot of things that go on on the Earth that you couldn't get any other way, and in a sense opening up a whole new area, shall I say, Senator, a frontier, a frontier based on science but it is a frontier much broader than science.

Well now, fellows, I don't want to wear you out before the Vice

President gets here so I'm going to sit down. (Applause)

_____: Let me say this. I think all of us could have stayed here a lot longer than Jim could have to hear what he had to say. And if we may, we haven't received the signal - Bill Bennett hasn't looked in here in the last fifteen minutes. I think he's gone out and cut his wrists or something, Dean, (Laughter) but perhaps he will. But maybe we'd like to impose on you a little more for asking questions and answers. Would you be willing to do that?

MR. WEBB: All right. You don't think people want to get a little break here before the VP comes.

_____: I think we'd like to hear some more of what you're telling us. That's the kind of stuff you've been talking about, way up there where we can do some planning ahead. Does anybody have a question?

_____: (Telling about arrival of Vice President)

QUESTION: (Inaudible)

MR. WEBB: Well as you know, the sun acts up over a period of about eleven years. It goes from a quiet period to a high period in the international geophysical year which really did a lot to sort of kick us off in the Frontiers of Science Foundation because the scientists really got together on a worldwide basis. They made a lot of measurements at an active time of the sun. Then we went through a period where we had a quiet sun. We had the international year of the quiet sun which has been completed I guess about a year and a half, two years ago. Now it's

beginning to act up. And of course when you get a large number of eruptions on the surface of the sun, you get much more activity out in space and you're able to measure things a lot better. What we find, for instance, is there's something roughly equivalent to an accelerator in the sun that turns itself on and off in less than two thousandths of a second. But it'll double the amount of output within just an instant. And then all of a sudden it decreases instantly. Nobody quite understands how that happens but we do know from the measurements in the higher reaches of the atmosphere that it causes important changes in the ionosphere and the atmosphere and that some of that is a kind of a chemical change induced by the combination of light and other things there, that that works its way down to the atmosphere and affects us here on Earth. And you know that it affects the weather and the total energy input in the air. And this kind of knowledge that will incite a lot of minds, you see, to work further on those problems.

Does that answer what you had in mind?

_____: Very good.

MR. WEBB: We have an orbiting solar observatory, we've launched two now. We're going to keep one in orbit continuously for eleven years so we'll make continuous measurements near the Earth. We have satellites reaching out a few hundred thousand to a few million miles. So we're taking measurements constantly over this period of time. Completion of that eleven-year cycle will give us a lot more valuable information than just one or two measurements sporadically taken.

QUESTION: (Inaudible)

MR. WEBB: That we have done here under the law that said we must

consult the scientific community as to what we do in the making of our program and then report back to them, we've asked them to come into session about once every three years, to examine completely our program, and then we've asked the National Academy of Sciences to organize a space science board and they meet about once a quarter. They're going to be here this week. And they spend a number of days in examining in very great detail what goes on for the National Academy of Sciences, which in turn reports to us and publishes the thing for Congress and everybody.

Now the first real meeting, when I became administrator, was out at the University of Iowa with Jim Van Allen and his group and they made a long report as to what they thought ought to be done, including the fact we ought to give more support to ground-based astronomy, and that we could get further by doing that than we could by sending out spacecraft.

We were immersed in a program of developing the rocket engine and its capability and investing about a billion dollars in a worldwide network by which we could work with spacecraft all over the world or out as far as Mars. And we also were deeply concerned as to whether we should try to go into things that other agencies of the government were capable or had requirements and responsibilities. The Science Foundation, for instance, has quite a bit of responsibility for astronomy.

So we have only in a limited way supported ground-based astronomy insofar as large telescopes are concerned. We have helped to finance some where there was a gap in the area they could cover. But we have provided money to accumulate into repositories information that has

come from astronomy. For instance, out in Arizona we have built a building and have furnished the money by which all of the pictures of Mars, running back to the eighteenth century, have now been brought together in one collection and can be examined. So this has been our policy.

Now last summer, a year ago, we had a meeting at Woods Hole for three months of this same group. They went over the whole thing again. And they said following your landing of man on the moon, we do not think you ought to try to build a big lunar base as a first priority or try to build great orbiting systems around the Earth as the first priority. We think the next priority ought to be to go to Mars with the fullest kind of measurement so that you can compare Mars and the Earth and also find out if there's life there.

Well, there's a good deal of debate now between the people who want to do that and the astronomers who want us to put up some very large telescopes in space and some of these are 120 inch. We have proposals to put 120-inch telescopes in space, erect it with men working outside a capsule, just like White, you know, outside his capsule, and build this thing in space.

We've also got proposals such as that with the kind of reflecting mirror you could put up you could illuminate, let us say, Vietnam, where at night time it'd be bright enough so that you could see what's going on like you could in the day. All kinds of proposals like that are going on. (Laughter)

The question of astronomy is very difficult. So what we've done here is we've made a real breakthrough. A great many of the brightest

scientists have always sort of felt that, well you know those rocket boys, they're going to have to race, they want to get astronauts on Broadway, and they're hoopla people. So a lot of the brightest ones have sort of stayed away. People like Foster that you heard talk. They sort of felt, you know, maybe this is not exactly pure and clean like science ought to be. (Laughter)

Well they changed their minds and now we have a committee, which Dr. Norman Ramsey of Harvard is heading, and I'm going to meet Dr. Leo Goldberg from Harvard tonight for dinner. And these people are now coming in. Louis Alvarez who is out in the same laboratory that Foster came from. They all now are coming in to really examine with the greatest of care what can be done with these systems that go out beyond the air's atmosphere. They can accumulate vast amounts of knowledge you could never get on the surface of the Earth.

I would suspect that by about six months we'll have a very thorough analysis of this problem of Astronomy as to what we should do ground-based, what others should do ground-based, how much of it should be done from orbiting space stations, and how much can be done by even going further out and using rockets to go long distances out from the Earth.

But I don't think anybody can fully answer that question. Nobody could give you an opinion (~~Inaudible~~ everyone can agree on but there are lots of astronomers would like nothing better than to have a substantial sum of money made available to them to build ground-based observatories. They also point out you're never going to train enough astronomers with the present facilities.

One of the things I'm going to talk in Europe about is whether or not you really put an international observatory in orbit which is not just a spacecraft carrying a few experiments that people designed on the Earth, but really where people can conduct experiments they never thought of at the time (Inaudible) This is one of the next steps that will undoubtedly come out of this.

QUESTION: (Inaudible)

MR. WEBB: Well it doesn't look like it's going to be a problem for some time. For a long time the theory with respect to the micrometeorite population was that it was a real danger and a lot of people thought that the Earth's field, its effect on the environmental space made the concentration around the Earth greater than they would be elsewhere. This was true to some extent. But by and large, there's so much space there that you're not going to have so much trouble unless you just sort of launch deliberately in the path of another object, which we did with Gemini VI and VII as you know.

So if you use reasonable caution, there's not much danger. I do think the real problem is to keep up with your things as the Earth turns. I mean the fellows communicating with spacecraft and having enough patience to do this effectively and to, in a sense, bring them back where you want them or put them where you want them is a very real problem. I don't know of any very real problem with respect to space jumps.

Now some of that stuff is dropping around the world. We used to think every bit of it would burn up but it doesn't quite all burn up. (Laughter)

QUESTION: (Inaudible)

MR. WEBB: Well first of all, we are very bold in our concept in the Space Agency and very conservative in our engineering. Now there are no breakthroughs required for the engineering of the systems to go to the moon. We're proceeding on a program we laid out five years ago as a ten-year program. We said then it would cost $20 billion, 20 to 40. We're still on that schedule and we'll do it within a very small percentage, 1% maybe or 1% of the $20 billion. So the engineering was done and we have been able to execute it, cutting out some parts of it. Several things we have done differently but the cost has escalated 20% in American industry where we spend 90% of our dollar. So every hour of work we are getting from American industry now costs us 20% more than it did when we planned the program five years ago. But we've been able to compress things and still stay pretty much on schedule.

Allen, I think there's a strong misconception around about breakthroughs. Certainly the splitting of the nucleus of the atom was a real breakthrough and a few things like that. But these programs are not based on what you call breakthroughs. They're based on a constant addition of instruments of knowledge so you understand the environment very precisely. Then you tailor a machine fully and completely to operate in that environment, like, say, the Boeing 707 is tailored to operate at certain altitudes with a certain amount of efficiency and to carry certain pay loads. We do that to an extreme degree with our vehicles. So efficiences are coming through more careful measurements and understanding of the environment and then better materials, better use of materials, better lubricants and just shaving weight out of the vehicles. We find now that some of the safety factors we used to build

into them are not required, so we cut them out. They weigh.

Now with respect to your second question which was, what, I forgot. Oh sure, I mean the Van Allen Belts are there. They are measured physical phenomena. There's radiation. If you go through them in a hurry you don't accumulate enough radiation to bother you with (Inaudible) If you stay and fly in them, it'd take a tremendous amount of shielding to keep a man from being damaged.

The problem we've had with some of our flights is there's a little dip in the Van Allen Belt over the South Atlantic over near Africa and to get up above 140, 150 miles you'll go through that little dip in the belt every time you go around the Earth. So we were somewhat concerned about that. The Russians were too. In some of their flights they sent an unmanned spacecraft up every time before a manned flight in case there was radiation.

I would say that if you know it's there it's no problem if you're going through it. But you've got to fly below it or above it with men and, also it does affect equipment. I mean it deteriorates equipment there much more rapidly than it would deteriorate in some other part of the space environment.

QUESTION: (Inaudible)

MR. WEBB : Well I've said this several times publicly and I don't mind saying it publicly. Well first of all, two years ago I stated to the Congress that I did not believe the Russians could match the capability we would develop with the Saturn V, which could put 280,000 pounds into orbit or send 95,000 toward the moon. That's enough to make the landing and get back home.

Now a year ago when the program had been reduced I stated that if it took the full fifteen flights of the Saturn V to make the luna landing we wouldn't do it in this decade. But if we could do it, say, on twelve flights or thirteen, we'd still accomplish it within the decade and about within the cost estimates. But it cost about a billion a year to spread the program out to do the same work. At that time I stated that we felt quite confident, this was a year ago, that our program was progressing to where we would be passing them in the large spacecraft field and in the manned spacecraft field. I said the other day, which I repeat, I'm much less sure of that today and I am as sure as I could be of anything that they have a program that is the rough equivalent of ours in every way and even with the Saturn V.

For those of you who didn't hear me at Houston or Oklahoma City, I'd like to tell you that if you've flown in a Boeing 707, which is a big airplane, the Saturn V has got the power equivalent of 6,000 Boeing 707s in it. And each one of them has got four engines. In other words, you take 24,000 engines of the size that fly a Boeing 707, we put all of that power into one machine, the Saturn V. So it's a tremendous thing and you deliver all of that power in a very short period of time to get up to high speeds and travel in space.

Now the Russians are going to be able to put up as big loads as that or bigger if they want them. They're not going to be limited by their boost capability in anything they want to do. Further, they've flown their 10[illegible] Cosmos satellites. They've shown this tremendous capability to make a soft landing on the moon. This is no small matter. If you start out and had to design a piece of equipment to land on the moon,

those of you who are used to drilling down to 20,000, 22,000 feet, you got a lot more problems than you got in the bottom of that deep well. And they showed before the eyes of the world they could do it. So don't underestimate what they're doing. The real $64 question is why are they doing it. Why are they making this tremendous investment? And a lot of people think it's because they can't upgrade that total scientific, technical, engineering, management system, that they can only get something like 60, 65% efficiency out of large segments of their economy. So if they can develop one that they can 95% out, they'll learn from that and apply it all the way through the rest of their system and that this is part of their major objective.

So I would say that they are ahead of us now, that they will be ahead of us in most major fields, except these applied fields like communication satellites and weather satellites, for at least two years under our present system and under the impetus behind our present system, and if they proceed at the rate that they're going.

So you just as well put it in your book that we're in for some very unpleasant and painful years of astern chase.

QUESTION: (Inaudible)

MR. WEBB: Well, I would say that you have got a whole new industry built on pyrogenics that probably would not have been possible except that you've got these very cold liquids cheaply and even in making a spiel, Dean, I think you'd say this. I was up in Cleveland I guess about eight or nine months ago and I asked the vice president of the Republic Steel Company how many furnaces he was running. And he said, well when you were in Republic (Inaudible) we were running fourteen. Now we're

running two. Actually we could produce the whole output with one but if one broke down we want to have the other one running.

Now this kind of an upgrade has occurred in many of the basic industries around the country with an improvement of quality because they can get liquid oxygen cheap and they could measure the output, so that they don't have to run out a whole string of plate or wire and go and measure it with a micrometer - this is exaggerating a little - so that they can actually measure every foot of it when it comes out and know what they've got and adjust the equipment so it turns out good stuff.

Now in the medical field tremendous progress has been made with respect to these sensing devices and the ability to understand what's going on in the human body and moving right on to the application of total systems engineering as we use it to the development of an artificial heart. All of that is moving very very rapidly.

Now one other thing, George, that I think is extremely important and that is that a great many people who thought research was magic, that basic research somehow would open all doors, have found that without the association with technology, engineering and management it doesn't work. So in a sense, the largest corporation beginning today instead of trying to spend a lot of money for basic research, they want to see it done in universities but they want a better interface between their engineering and technology and the basic research in universities. This might be something to look at very carefully in Oklahoma. If you could find a way to do that, I think this would be a very very important thing because nobody that I know of has found a very good way to do that.

One last point with respect to the fallout. We have tried very hard to make information available. I expect we've published as many as twenty State of the Art reviews where we follow basic formulas here where if basic research goes, every once in a while you want to summarize the latest results in the State of the Art review and then some engineer comes along and says well there's enough in that State of the Art review to design a new machine. I didn't think I was ready. Now I'm ready and I'll try. Then you got to follow up, as we do all the time in aviation and space, with development or research in support of that development because he doesn't get enough from that State of the Art review really to do the whole job. So he runs up against a problem. You've got to do research to solve that problem to get an efficient machine.

Now this is the process that's going on on an accelerated tempo all over this country. In a whole state like Pennsylvania where there may be 150 companies working in our program under competitively won contracts in some area of new technology, you will see a tremendous advance with respect to what was at one time a sort of moribund industrial system, in eastern Pennsylvania for instance. Now you begin to see this all around the country.

Don't you think that's about enough? (Applause)

QUESTION: (Inaudible)

MR. WEBB: What I believe to be dependable and they have lost none so far as we know. This is just a bunch of rumors. People just don't believe the Russians can do what they do and they spread these rumors. But there's absolutely no information or data or anything reliable that

would indicate they've lost a single man in space flight. They've lost some on the ground just like we have. I wouldn't just downgrade the Russians by assuming you know that they are callous about life. They are callous about 20 million people they let starve in order to accumulate industrial capital to get going. Or they were quite callous during the war when they'd take people and walk them across the airport to clear the butterfly bombs and let everyone that hit a bomb get blown up. But when it comes to individual life they are as careful as we are.

_____: I believe you'll agree with me. This is the best program you have had or will have (Applause).